GP Big Island, LLC

INFORMATION FOR VPDES PERMIT RENEWAL APPLICATION

CLEAN WATER ACT SECTION 316(B) COMPLIANCE

VPDES PERMIT VA0003026

Big Island Mill – Big Island, VA

October 2019

VPDES PERMIT RENEWAL APPLICATION INFORMATION FOR 316(B) COMPLIANCE

Todd R. Boykin, PE (VA)
Principal Engineer

Prepared for:

GP Big Island, LLC

9363 Lee Jackson Highway

Big Island, VA 24526

Prepared by:

Arcadis U.S., Inc.

9954 Mayland Drive

Suite 2400

Richmond

Virginia 23233

Tel 804 740 0181

Fax 804 217 8292

Date:

October 2019

CONTENTS

1 INTRODUCTION

On August 29, 2014, revisions to Sections 122 and 125 of Chapter I, Title 40 of the Code of Federal Regulations (CFR) were promulgated under authority of Clean Water Act (CWA) Section 316(b). This section allows for regulation of the design and operation of "cooling water intake structures" (CWIS) in the interest of protecting all lifecycle stages of fish and shellfish and "minimizing adverse environment impact". §316(b) has been an enforceable part of the CWA since 1978, and the states have administered it, to varying degrees, through NPDES permits by applying Federal guidance, Best Professional Judgment (BPJ), and state-specific regulations and guidance. With this 2014 rulemaking, prescriptive and uniform Federal standards are now applied by the states to provide national standards to minimize adverse environmental impacts for fish and shellfish against impingement (trapped against the intake screen or within the CWIS system) and entrainment (passing through the facility's CWIS and cooling system) by requiring states to determine Best Technology Available (BTA) for design and operation of a CWIS.

Subpart J of 40 CFR 125 establishes the requirements of §316(b), which apply to any "existing" facility that owns and operates a "cooling water intake structure" (note that "new" facilities are also subject to §316(b) but with requirements different than those for "existing" facilities). To understand these terms, the following abridged definitions are provided from 40 CFR 125.92:

1) *Existing facility*: any facility that commenced construction on or before January 17, 2002.
2) *Cooling water intake structure*: the total physical structure and any associated constructed waterways used to withdraw cooling water from waters of the United States. The cooling water intake structure extends from the point at which water is first withdrawn from waters of the United States up to, and including the intake pumps.
3) *Cooling water*: water used for contact or non-contact cooling, including water used for equipment cooling, evaporative cooling tower makeup, and dilution of effluent heat content. Cooling water that is used in a manufacturing process either before or after it is used for cooling as process water, is not considered cooling water.

GP Big Island LLC owns and operates an existing paper mill on the west shore of the James River in Bedford County, Virginia, approximately 18 miles northwest of the City of Lynchburg. The Mill commenced operation in 1891 and utilizes the James River, a Water of the United States (WOTUS), for its hydro-generator (the flow for which is not subject to §316(b) compliance and thus not included in this reporting), cooling, and process purposes. Water is withdrawn from the River into a CWIS, and the withdrawal point of the CWIS at the WOTUS is along the west shoreline of the River immediately north of the Mill.

Because the Mill is an existing facility with a CWIS, it is subject to §316(b) compliance.

40 CFR 125.91(a) establishes the following three criteria which all must be satisfied for an existing facility to be subject to the impingement and entrainment BTA determination requirements of §125.94 through §125.99.

1) *The facility is a point source*. The Mill is subject to the requirements of VPDES permit VA0003026 and is thus considered a point source.
2) *The facility's Design Intake Flow (DIF) is greater than 2 MGD*. The (DIF), which is defined at §125.92(g) as the maximum instantaneous flow that the CWIS is physically capable of withdrawing, is 21.6 million gallons per day (MGD).
3) *25% or more of the withdrawn water is used exclusively for cooling purposes*. The Mill's three-year average percentage of exclusive cooling water use is 24.1%

As the Mill's CWIS fails one of the three "applicability" criterion (the 25% exclusivity limit) at §125.91(a)(3), it is not subject to the requirements of §125.94 through 125.99, which requires the facility to select one of the prescribed impingement BTA options at §125.94(c) and for the state agency to establish site-specific entrainment BTA. However, §125.90(b) indicates that facilities not subject to §125.94 through §125.99 "must meet requirements under section 316(b) of the CWA established by the Director on a case-by-case, best professional judgment (BPJ) basis."

Because the Mill is not subject to the requirements of §125.94 through 125.99, site-specific BPJ must be used to establish BTA for impingement and entrainment.

As a part of the CWIS permitting process, which is a component of NPDES permitting, the facility must provide information that characterizes the source waterbody and its biology, the CWIS, and the facility itself. The information requirements are defined at §122.21(r)(2), (3), (4), (5), (6), (7), and (8). This reporting comprises the 316(b) permitting and compliance demonstration for existing facilities with an Actual Intake Flow (AIF) less than 125 MGD. The Mill's AIF, which is defined at §125.92(a) as the average volume of withdrawn water on an annualized basis for the previous three years (excluding emergency and fire flow,) is calculated to be 14.2 MGD. As such, information contained within the §122.21(r)(9), (10), (11), and (12) reports are not required to be submitted.

The intent of this report is to provide technical and quantitative information for the Virginia Department of Environmental Quality to facilitate a BPJ-based determination that the Big Island Mill CWIS represents BTA for impingement and entrainment and that no additional controls are warranted to further minimize adverse environmental impact.

2 SOURCE WATER PHYSICAL DATA [§122.21(R)(2)]

As required by 40 CFR 122.21(r)(2), this section provides Source Water Physical Data, such as areal dimensions, depths, and temperature regimes, for the reach of the James River where the Mill is located, as well as information on the Mill's CWIS location.

2.1 Description of the Source Water Body

The Mill utilizes a CWIS that draws cooling water from the non-tidal zone of the James River in Bedford County northwest of Lynchburg. Cooling water discharges to the James River via a permitted outfall.

2.1.1 James River

The Mill is located approximately 200 miles southeast of the beginning of the James River at the confluence of the Jackson and Cowpasture Rivers in western Virginia near Clifton Forge. The Mill is located approximately 150 miles from the river's mouth at the Chesapeake Bay in the Middle James River Basin. The Big Island Dam (Dam) is located at the Mill and was built in 1850. It extends the entire width of the river, a distance of approximately 450 feet and is at a height of approximately 15 feet from the River bottom. The Dam is constructed of masonry and timber and is of a crib design. The Dam creates an upstream pool of over 110 acres that facilitates the provision of electrical hydro-generator supply water, in addition to Mill process and cooling supply. Bathymetric information is not available to ascertain the depth of the headwater zone, so it is valid to assume that the depth is approximately 15 feet.

The withdrawal point of the CWIS at the Water of the US (WOTUS) is along the west shoreline of the River immediately adjacent to the Mill and at the emergency spillway of the Dam. A manmade forebay is used as a large channel to direct withdrawn water to a series of intake bays.

To the Mill's knowledge, the intake is not located in a reach of the James River where in-river fisheries are stocked and managed by a State or Federal natural resources agency of the equivalent. Rocky Row Run is a National Forest water located 5 river miles upstream from the CWIS and is a Designated Trout Water. This waterbody is generally stocked with catchable trout three times between October 1 and April 30.

2.1.2 Water Quality

According to the 2018 303(d) list for impaired waters in the Commonwealth of Virginia, there are no Category 5 waters listed within a 5-mile radius of the Mill.

2.2 Hydrological Features of Source Waterbody

2.2.1 Hydrology

According to the USGS Gage 02024752, located approximately 1.4 miles upstream of the CWIS, the mean daily discharge measured at the gage since 2006 has been 3,710 cubic feet per second (CFS) or 2 billion gallons per day.

2.2.2 Cooling Water Intake Structure Area of Influence

A desktop calculation was performed to estimate the hydraulic area of influence (AOI) of the Mill's CWIS in the forebay from the point where the water enters the intake pumphouse bay which leads to the travelling screen and intake pumps. This parameter provides important context to understanding an intake's "reach" into the adjacent waterbody and how it's withdrawal hydraulics could physically impact motile fish that happen to be in the vicinity.

A simple calculation can be performed to approximate a set of radial velocity contours that extend from the face of the intake slots into the forebay. The table below indicates the approximate distance off of the face of the intake slots of a generally radial-shaped water velocity contour created by the design or actual withdrawal flow from the intake pumps.

The federal 316(b) rule states that 0.5 foot per second (fps) is the water velocity at which most fish are able to continue to swim freely without being negatively influenced and thus able to escape the current at will. Though the 316(b) rule does not provide a specific velocity or velocities that define the AOI, the Rule uses 0.5 fps as a velocity standard for impingement mortality reduction.

Hydraulic Area of Influence

Velocity Contour	Design Flow (21.6 MGD)	Actual Flow (14.2 MGD)
0.5 fps	2.4 feet	1.7 feet

For context, the intake bay entrance is located approximately 70 feet from the River's edge. As such, the Mill's CWIS' AOI does not extend into the River proper.

2.3 Locational Maps

Locational maps showing the facility in reference to the overall waterbody are included in the Appendix.

3 COOLING WATER INTAKE STRUCTURE DATA [§122.21(R)(3)]

3.1 Narrative Description of Cooling Water Intake Structure Configuration and Location in Water Body

3.1.1 Cooling Water Intake Structure

The Mill has one active CWIS that supports production operations related to cooling and process. The CWIS has a forebay and structure with several intake bays that supply either a water withdrawal pump wetwell or the Mill's hydro-turbine electrical generators (hydro-generators). The intake bay for the withdrawal pumps is not interconnected with those of the hydro-generators. Because the hydro-generators are not associated with the Mill's cooling water system and because they are regulated separately by the Federal Energy Regulatory Commission (FERC), they are not subject to the 316(b) regulation, and the flow associated with that process not considered as a part of the CWIS calculations.

The withdrawal point of the CWIS at the WOTUS is along the west shoreline of the James River immediately north of the Mill. A manmade forebay is used as a channel to direct water from the upstream area of the Mill's dam to the inlet bays. Because this forebay is a "constructed waterway used to withdraw water from a WOTUS", it is considered a part of the CWIS per the definition found at 40 CFR 125.92(f). The forebay is triangular in shape and is approximately 140 feet (opening length parallel to the River) by 115 feet (width perpendicular to the shoreline) by 10 feet deep (on average, subject to sedimentation and periodic dredging). A 140-feet floating boom (known as the "log-boom"), extending approximately 4 feet deep and spanning the opening of the forebay, prevents large floating debris from entering the forebay.

Flow from the forebay can enter one of three equally-sized concrete bays that are each protected by a bar rack with 1.5-inch spacing and a 0.38-inch bar width. Two of the bays provide flow to the two hydro-generators. The third bay (Bay #1) supplies water to the three river water intake pumps and the fire service pump. The bar rack is the first structure that spans the entire water column and thus the first physical structure that a fish would likely encounter in the CWIS. The racks are periodically cleaned as needed by a rail-mounted grabber rake.

Bar Rack Information Summary Table

Parameter	Value
Total Rack Width at the Bay	10.5 feet
Individual Bar Width	0.38 inches
Bar Spacing	1.5 inches
Effective open area (%)	72
Wetted Rack Depth at Low Water	8.2 feet

After the bar rack, water passes through a conventional travelling water screen (Rex /Evoqua), with 0.5-inch mesh and then into a wetwell for pump suction. The travelling screen basket width is 4 feet. The distance from the headshaft to the footshaft is 27 feet, fitting into a rectangular channel with a constant floor elevation between the bar rack and the screen (approximately 8 feet distance). The screen is rotated and cleaned with a high-pressure spray based upon differential water level measured on either side of the screen. The resulting debris is sluiced through a channel and back to the River.

Travelling Screen Information Summary Table

Parameter	Value
Screen Mesh Opening Size	1/2 inch
Screen Basket Width	4 feet
Total Screen Height	27 feet
Design Low Water Depth	8.2 feet

The wetwell is bounded by walls, and water does not pass beyond this point.

There are three river water intake pumps. Depending on Mill needs, either one or two pumps normally operate at one time, but all three can be operated based on Mill demands. Totalized flow from a meter on the river pumps' discharge manifold measures the total withdrawn water. There is one fire service pump that also withdraws from Bay #1, and its flow is not part of the flow values provided in this report.

3.2 Cooling Water Intake Structure Geographical Location

The CWIS is located at latitude 37° 32' 10.00" N and 79° 21' 28.34" W.

3.3 Cooling Water Intake Structure Operation

3.3.1 Design and Actual Intake Flows

There are three river water intake pumps, which conjunctively provide flow to the Mill's cooling and process water systems. Depending on Mill needs, either one or two pumps normally operate at one time, but all three can be operated based on Mill demands. The nameplate flow capacity of each pump is

7,500 gallons per minute (GPM), which is equal to 10.8 million gallons per day (MGD). Information on the design flow for parallel operation is not available. Instead, perspective on the likely DIF is gained by observing the maximum daily intake flow recorded during the period of service of the current pumps (installed in 2011), which was 21.6 MGD (15,000 GPM) recorded in both 2013 and 2014. This flow does not include flow from the Mill's one fire service pump, which also withdraws from the Bay #1 wetwell as previously described, in accordance with the definition of DIF. Specifically, 40 CFR 125.92(g) provides the following definition of design intake flow:

> *[T]he value assigned during the cooling water intake structure design to the maximum instantaneous rate of flow of water the cooling water intake system is capable of withdrawing from a source waterbody. The facility's DIF may be adjusted to reflect permanent changes to the maximum capabilities of the cooling water intake system to withdraw cooling water, including pumps permanently removed from service, flow limit devices, and physical limitations of the piping. DIF does not include values associated with emergency and fire suppression capacity or redundant pumps (i.e., back-up pumps).*

Using best professional judgement in light of available information, the DIF is 21.6 MGD.

The CWIS is in operation 24 hours a day, 365 days a year, except during Mill outages and screen maintenance events. The Mill's cooling systems require less cooling water during the winter, which leads to seasonal variations in intake flow. However, there are no seasonal process changes which contribute to intake flow variation. Actual water withdrawal through the river intake pumps is measured for all operating pumps by a single magnetic flow meter. Specifically, 40 CFR 125.92(g) provides the following definition of AIF:

> *[T]he average volume of water withdrawn on an annual basis by the cooling water intake structures over the past three years. After October 14, 2019, Actual Intake Flow means the average volume of water withdrawn on an annual basis by the cooling water intake structures over the previous five years. Actual intake flow is measured at a location within the cooling water intake structure that the Director deems appropriate. The calculation of actual intake flow includes days of zero flow. AIF does not include flows associated with emergency and fire suppression capacity.*

As stated above, the AIF for the complete three-year period of record (2016 through 2018) is 14.2 MGD. The following table summarizes the average intake flows by month, which comprise the AIF calculation.

CWIS Average Intake Flow, 2016-2018

Month	Average Intake Flow (gpm)	Average Intake Flow (MGD)
January	8,970	12.9
February	9,049	13.0
March	8,751	12.6
April	9,166	13.2
May	9,972	14.4
June	10,682	15.4
July	11,217	16.2
August	10,708	15.4
September	10,642	15.3
October	10,392	15.0
November	9,691	14.0
December	9,009	13.0
Actual Intake Flow (AIF)	**9,854**	**14.2**

3.3.2 Point of Compliance

In making the determination of the point of compliance's location, reference is provided to the 316(b) rule's definition of a cooling water intake structure, found at FR Vol. 79, No. 158, Pg. 48431, which states the following:

> *[T]he total physical structure and any associated constructed waterways used to withdraw cooling water from waters of the United States. The cooling water intake structure extends from the point at which water is first withdrawn from waters of the United States up to and including the intake pumps.*

Defining the CWIS to start with the first point of withdrawal makes sense from a physio-biological standpoint, as it is the first physical hardware encounter with the intake system that an organism would have upon an approach to the screen. Additionally, this first point of withdrawal is the point at which the CWIS's hydraulic AOI is measured.

The point at which velocity determinations are made is not specifically defined in the rule, and discretion is granted to the state agency. As stated in the preamble (FR Vol. 79, No. 158, Pg. 48308)

> *Because a facility may withdraw cooling water from a water of the United States either directly or as makeup water for a closed-cycle cooling system, the Director may determine where within a facility's cooling water intake structure is or are the facility's point or points of compliance.*

In the case of the Big Island Mill, the point of compliance could be designated as the forebay's log-boom, which is located at the interface of the CWIS with the WOTUS. Acknowledging, though, that the conjunctive flow through this interface for cooling/process and hydroelectric purposes is difficult to quantify and acknowledging that the interface could be impacted by periodic river-influenced hydraulic scenarios that preclude a clearly defined AOI, the designation of the point of compliance within the CWIS at the bar rack is justified. Therefore, the through-slot velocities, design and actual intake flows, and AOI have been calculated as a function of the bar rack and its location.

3.3.3 Design and Actual Through-Slot Velocities

The bar rack is located at the face of the pumphouse bay, approximately 70 feet from the log-boom and is the first structure which spans the entire water column that any aquatic organisms would encounter if swimming through the forebay and directly to Bay #1.

Through-slot velocities (TSVs) were calculated for the outer screen at the DIF and AIF conditions, as previously defined. A 10% debris blockage factor was used in the velocity calculation, as the rule requires that the calculation be made using "periods of maximum headloss across the screens or other devices during normal operation". Considering the dimensions of the bars and their spacing and in conjunction with the assumed debris blockage, the resulting effective open area of the bar rack is calculated to be 72%. To incorporate the "minimum ambient source water elevation", the travelling screen's minimum design water height is used in the velocity calculations provided in the tables below.

The table below shows the TSVs calculated at the AIF and DIF. One of the prescribed impingement BTA options (40 CFR 125.94(c)(2)) is operating the CWIS with a "design" TSV no greater than 0.5 fps, which is a function of the DIF. Adhering to the precision used in the rule, the Mill is compliant with this BTA option because the TSV at the DIF is also 0.5 fps. The table provides the TSV to the hundredths place to demonstrate that the value would not be rounded up. The TSV at the AIF is provided for context.

Bar Rack Through-Slot Velocities, AIF and DIF (2016 – 2018)

Flow	Flow (MGD)	TSV (fps)
AIF	14.2	0.35
DIF	21.6	0.54

The table below shows the TSVs at the maximum daily withdrawn flow for each of the past three years. One of the prescribed impingement BTA options (40 CFR 125.94(c)(3)) is operating the CWIS with a "actual" TSV no greater than 0.5 fps at any point during normal operation of the CWIS. As the values in the "Max Daily TSV" demonstrate, the Mill's TSV never exceeded 0.5 fps during the period of record. As such, the CWIS would comply with the aforementioned impingement BTA option. The "average annual TSV" is provided for context in comparing the one-day annual maximum value against an "average" day for that year.

Annual Average and Maximum Bar Rack Through-Slot Velocities (2016 – 2018)

Period	Average Intake Flow (MGD)	Average Annual TSV (fps)	Max Daily Intake Flow (MGD)	Max Daily TSV (fps)
2016	13.9	0.35	19.8	0.49
2017	14.0	0.35	19.3	0.48
2018	14.7	0.37	18.0	0.45

3.4 Water Balance Diagrams

A water balance diagram is included in the Appendix.

3.5 Engineering Drawings

Engineering drawings of the cooling water intake structure are not readily available. As an alternative, a schematic of the system is provided in the Appendix.

4 SOURCE WATER BASELINE BIOLOGICAL CHARACTERIZATION DATA [§122.21(R)(4)]

This section provides information on the biology of the source waterbody in order to characterize the biological community in the vicinity of the CWIS at the Mill and to characterize the operation of the CWIS. The information provided herein relies on information from the "Application for Licenses for Big Island and Holcomb Rock Hydroelectric Projects, December 1998" (FERC Application) completed by the Mill and from information pertaining to maintenance activities at the Mill's forebay.

4.1 Species in the Vicinity of the Cooling Water Intake Structure

A field study was not conducted as a part of this 316(b) reporting, so relevant existing information contained within the FERC Application is relied upon to provide perspective on the site-specific biological conditions in the River.

4.1.1 Summary of the 1997 Field Study

As a part of the FERC application, a biological field study was conducted in September 1997 to understand the composition of fish species in the vicinity of the Dam. Electrofishing methodology was deployed. The following is a summary of the findings of the report:

1) "The fish community within the pool area above Big Island Dam was mainly smallmouth bass, bluegills, and Roanoke darters. Of the 14 fish species found, these three species accounted for 57% of the fish present. No American eels were observed during surveys above or below Big Island Dam." (FERC Application, page 5-13)
2) "Past surveys indicated that over the years, a total of 35 fish species have been collected from the James River in the vicinity of the [Dam and the downstream Holcomb Rock Dam]. Size distribution of collected individuals for most species showed evidence of a reproductive success. The percentage of smallmouth bass in the [Dam] vicinity indicates that this species is a dominant component of the fish assemblage." (FERC Application, page 5-13)
3) A two-day mussel survey was conducted in September 1997 and September 1998 along the River reach from the Dam's reservoir to the Holcomb Rock Dam and included several tributary creeks. The James Spineymussel and the Green Floater were identified as species of concern, but neither species was encountered during the study.

The 316(b) rule prefers that biological studies utilized in this characterization not exceed ten years of age, unless it can be demonstrated that conditions have not changed in such a way that renders the information obsolete. It is the opinion of the Mill that observable physical conditions of the Dam and its upstream reservoir have not changed over the past 25 years in such a way that would reasonably exclude use of this 1997 field study information for generally characterizing the River's biology.

4.1.2 FERC Application Commentary of Impingement and Entrainment

The FERC Application provides insight into the possibility of impingement and entrainment at the Mill. The following is an excerpt from Section 5.4.5 – Fish Entrainment and Impingement.

> *Historically, there has been no reported incidence of significant fish mortality in the [Mill intake]. The VDGIF has indicated that impingement/entrainment does not appear to be a significant problem at the [Mill intake]. Continued operation of the [intake] similar to their historical operation may not result in significant fish entrainment or impingement. Nevertheless, the VDGIF requested a literature review of potential entrainment issues at comparable projects.*
>
> *The [Mill] conducted a review of 54 site studies which assess the likely magnitude of entrainment at [the Mill]. … [The Mill] estimated the potential entrainment rate at [the Mill] by comparing physical parameters of the [Mill] reservoir (e.g. surface area, volume) and intakes (e.g. intake depth, velocity) to the [Mill's intake]. Based on similarities of the physical factor it is anticipated that entrainment rate of Big Island will likely be in the order of 0.3 to 0.5-fish per million cubic feet.*

From this projection, the estimated volume of entrainment at the AIF is 0.6 to 0.9 fish per day. It should be noted that entrainment rates generally use eggs or larvae instead of "fish", as "fish" implies non-larval life stage. Regardless, it is clear that the estimated rate of aquatic impact is negligible.

4.1.3 Freshwater Habitat Study (2010)

In April 2010, the Mill commissioned a habitat and relocation study in accordance with Virginia Department of Game and Inland Fisheries' (VDGIF) request in consideration of a proposed forebay dredging project. The purpose of the study was to determine the presence of the Green Floater and its habitat within the forebay. The report concluded that, not only was the forebay devoid of the Green Floater, but the conditions in the forebay were unsuitable as habitat for the Green Floater and most other species of freshwater mussels.

4.2 Presence of Protected, Threatened, and Endangered Species

According to the VDGIF Fish and Wildlife Information Service the following listed aquatic species are "known or likely to occur" within a 5-mile radius of the Big Island Mill:

1) James Spinymussel (Federal Endangered / State Endangered) - mollusc
2) Roanoke Logperch (Federal Endangered / State Endangered) – fish
3) Yellow Lance (Federal Threatened) - mollusc
4) Rubble Coil (State Endangered) - mollusc
5) Shaggy Coil (State Endangered) - mollusc
6) Atlantic Pigtoe (Federal Proposed / State Threatened) - mollusc
7) Green Floater (State Threatened) – mollusk

Additionally, the reach of the James River at the Mill is listed as a "Threatened and Endangered Water" for the Green Floater.

5 COOLING WATER SYSTEM DATA [§122.21(R)(5)]

5.1 Cooling Water System Operation

5.1.1 Narrative Description of Cooling Water System (CWS) and its Relationship to the Cooling Water Intake Structure (CWIS)

The water withdrawn through the CWIS is used as once-through non-contact cooling water with a portion of this water being subsequently used for the paper production processes. The Mill produces power onsite with two hydro generators (flow not included in the values used in this report, as it is not cooling water) and a steam turbine. Non-contact cooling water that is not needed for process use is discharged to the James River via a VPDES-permitted outfall (Outfall 002).

5.1.2 Design Intake Flow Uses and Cooling Water System Operational Time

As stated previously, the DIF for the CWIS is 21.6 MGD (15,000 GPM) and the AIF, based on flow data for the intake pumps from January 1, 2016 - December 31, 2018, is 14.2 MGD (9,861 GPM). The table below shows the DIF utilization percentages.

DIF Capacity Utilization

Year	Average Daily Intake Flow (MGD)	Proportion of DIF Utilized
2016	13.9	64%
2017	14.0	65%
2018	14.7	68%
AIF	**14.2**	**66%**

Withdrawn water is utilized for cooling and process uses. 40 CFR 125.91(a) provides three criteria for applicability of the requirements in §125.94 through §125.99, which are requirements pertaining to minimizing adverse environmental impact by selecting a prescribed Best Technology Available (BTA) option for impingement mortality reduction compliance and for entrainment mortality reduction by BTA established by the agency on a site-specific basis. §125.91(a)(3) states the following:

> *Twenty-five percent or more of the water the facility withdrawal on an actual intake flow basis is used exclusively for cooling purposes.*

The table below provides data on the amount of withdrawn water used for cooling purposes. The water used for cooling is used exclusively for cooling.

Percent of Withdrawn Water Used for Cooling

Year	Average Daily Withdrawn Flow (MGD)	Average Daily Cooling Flow (MGD)	Proportion of Cooling Use to Total Withdrawn Flow
2016	13.85	3.27	23.4%
2017	13.99	3.50	24.9%
2018	14.73	3.52	23.9%
Average	**14.2**	**3.4**	**24.1%**

The Big Island Mill does not meet the twenty-five percent criterion and is therefore not subject to the requirements of §125.94 through §125.99.

In instances where the facility is not subject to these sections, §125.90(b) states the following:

> *Cooling water intake structures not subject to requirements under §125.94 through 125.99 or subparts I or N of this part must meet requirements under section 316(b) of the CWA established by the Director on a case-by-case, best professional judgment (BPJ) basis.*

The CWIS is in operation 24 hours a day, 365 days a year except during mill outage events that require suspension of intake use. The facility's utilities require less cooling water during the winter, which leads to seasonal variations in intake flow. However, there are no seasonal process changes which contribute to intake flow variation.

5.1.3 Proportion of Source Waterbody Withdrawn

The Mill is located 1.4 miles downstream from USGS gage 02024752. Flow data from this monitoring point was used as the source waterbody flow for the calculations in the table below, which summarizes the monthly average intake flow (based on flow data for January 1, 2016 – December 31, 2018) for the Mill and the proportion of the source waterbody withdrawn based on the corresponding monthly river flows.

Proportion of Source Waterbody Withdrawn by Month, 2016 - 2018

Month	Average James River Flow (MGD)	Average CWIS Intake Flow (MGD)	% Source Waterbody Withdrawn
January	2,126	12.9	0.6%
February	3,826	13.0	0.3%
March	1,943	12.6	0.6%
April	3,030	13.2	0.4%
May	4,655	14.4	0.3%
June	2,153	15.4	0.7%
July	796	16.2	2.0%
August	807	15.4	1.9%
September	1,722	15.3	0.9%
October	1,867	15.0	0.8%
November*	581	14.0	2.4%
December*	1,028	13.0	1.3%
AVERAGE	**2,045**	**14.2**	**1.0%**

** 2018 data not yet validated*

5.2 Existing Impingement and Entrainment Technologies and Operational Measures

The existing bar rack and the existing travelling screen are not "fish-friendly" as defined in the 316(b) rule relative to impingement mortality control technology. As such, the current infrastructure is not considered impingement and entrainment technology.

6 CHOSEN METHOD(S) OF COMPLIANCE WITH IMPINGEMENT MORTALITY STANDARD [§122.21(R)(6)]

Because the Mill's CWIS fails one of the three "applicability" criterion (the 25% exclusivity limit) at 40 CFR 125.91(a)(3), it is not subject to the requirements of 40 CFR 125.94 through 125.99, which require the facility to select one of the prescribed impingement BTA options at 40 CFR 125.94(c) and for the state agency to establish site-specific entrainment BTA. As such, 40 CFR 125.90(b) indicates that facilities not subject to 125.94 through .99 "must meet requirements under section 316(b) of the CWA established by the Director on a case-by-case, best professional judgment (BPJ) basis."

Regardless of the applicability failure, the Mill's CWIS complies with two of the prescribed impingement BTA options, which would facilitate DEQ's BPJ determination that the existing CWIS is BTA. The calculated through-screen velocities at the DIF and AIF comply with two of the twelve options at 40CFR125.94(c), namely options (2) and (3).

6.1.1 Design and Actual Intake Through-Screen Velocities Equal or Less Than 0.5 feet per second

The 316(b) rule is not explicit in the definition of a "screen" (*i.e.,* mesh size, material, location, etc.). With respect to the consideration of the design and/or actual intake velocity maximum of 0.5 fps as BTA, the rule acknowledges that there may be situations where there are "other devices" that are not screens, in the conventional sense, and some situations where there are no screens at all, which speaks to USEPA's expectation that the rule be applied based upon the consideration of the specific and unique conditions at a particular site. The following language is found at FR Vol. 79, No. 158, Pg. 48433.

> *The maximum velocity must be achieved under all conditions, including during minimum ambient source water surface elevations (based on best professional judgment using hydrological data) and during periods of maximum head loss across the screens or other devices during normal operation of the intake structure. If the intake does not have a screen, the maximum intake velocity perpendicular to the opening of the intake must not exceed 0.5 feet per second during minimum ambient source water surface elevations.*

In Section 3, through-screen velocities were calculated for the DIF at the bar rack. Under this flow scenario with design low water level and 10% blockage, the through-screen velocity was 0.5 feet per second, which complies with the impingement BTA option prescribed at 40 CFR 125.94(c)(2). Additionally, the through-screen velocities as a function of the maximum daily flow recorded in 2016, 2017, and 2018 was calculated at design low water level conditions and 10% debris blockage, and the velocity was less than 0.5 feet per second in all three scenarios, which complies with the impingement BTA option prescribed 40 CFR 125.94(c)(3)). Because the CWIS complies with 40 CFR 125.94(c)(2), no additional controls are required to comply with impingement mortality and velocity monitoring is not required.

7 ENTRAINMENT PERFORMANCE STUDY [§122.21(R)(7)]

The owner or operator of an existing facility must submit any previously conducted studies or studies obtained from other facilities addressing technology efficacy, through-facility entrainment survival, and other entrainment studies. Any such submittals must include a description of each study, together with underlying data, and a summary of any conclusions or results. Any studies conducted at other locations must include an explanation as to why the data from other locations are relevant and representative of conditions at your facility. In the case of studies more than 10 years old, the applicant must explain why the data are still relevant and representative of conditions at the facility and explain how the data should be interpreted using the definition of entrainment at 40 CFR 125.92(h).

7.1 Pre-Entrainment Mortality Studies

According to the Federal 316(b) rule, “entrainable organisms passing through the CWIS are to be counted as 100 percent entrainment mortality…” (FR Vol 79; No. 158 Pg 48378). However, studies have shown that a proportion of eggs and larvae entrained are already dead through natural means before entering the facility. Thus, the ability to differentiate between fish eggs and larvae that are clearly dead before entering the facility compared to those that are live or recently dead provides a more accurate assessment of entrainment mortality.

EPRI (2011) describes many studies where moribund ichthyoplankton are documented in aquatic environments and whose vitality is thus not primarily impacted by a cooling water system. Some causes of death include the following:

- disease or parasites;
- starvation;
- genetically-induced abnormal development or pathologies;
- environmentally-induced physiological distress or pathologies (water quality, water temperature, mechanical stress by waves, wind, and other turbulence, etc.);
- anthropogenic pollution-induced abnormalities or toxicity; and,
- for eggs, a lack of fertilization or defects preventing development.

In 2012, a larval fish survival assessment study was conducted at the Consumers Energy Company’s JH Campbell Generating Station on the eastern shore of Lake Michigan by the Great Lakes Environmental Center (GLEC 2012). The study was conducted since literature and previous similar studies at power plants suggested that a large percentage of larvae are already dead through natural means prior to entrainment. Additionally, drift netting larval capture methods and the methods’ impact on larval survival were evaluated. Further investigations into larval fish survival and mortality in the absence of cooling water system entrainment were also conducted through laboratory studies.

One sampling location, an intake channel that terminates at intake screenhouses, was selected for the study at Campbell. Plankton nets (500 micron mesh) approximately 2 meters long with a 0.5-meter diameter opening were used, and duplicate samples were collected. Different depths in the intake channel were sampled. Drift net samples were also collected during each sampling event. There were a total of six sampling events from June 14 to July 25, 2012. Any larvae collected were separated into live and dead, and the dead larvae were further separated into recently-dead and long-dead, based on specified criteria (GLEC 2012).

Of the 316 larval fish collected at Campbell, 293 were dead, translating to an observed mortality of 92.3%. Correcting for collection net mortality of 25.3% (based on fathead minnow trials), the estimated natural pre-entrainment mortality was 63.3%. That is, approximately 63.3% of the larvae that are entrained into Campbell through the intake channel may already be dead or moribund through natural means. GLEC (2012) suggested that estimation of natural pre-entrainment mortality should be considered as part of future entrainment sampling programs.

7.2 Through-Facility Entrainment Survival

This section provides information on earlier studies, including those more than 10 years old, which suggest that entrainment survival does occur for some species in some instances. The studies are based upon studies at power plants, as entrainment survival studies in other industries were not found. Even through the studies are greater than 10 years old, they are still considered valid because the general principles and operations of power generation cooling systems have not significantly changed over this time period such that the conclusions would be invalidated.

7.2.1 Literature Review

EPRI (2000) undertook a literature review of entrainment studies spanning three decades and reported survival rates of fish larvae following passage through a power station. The data were compiled from 36 studies covering 21 power stations and included approximately 50 different species and taxa groups. As over half of the studies were for Hudson River power plants, striped bass, white perch, clupeids (herring), and estuarine macroinvertebrates were prominently represented in the dataset. EPRI (2000) reported variable survival of fish larvae depending on the species. For example, fragile species, such as alewife and anchovies, experienced low survival rates (approximately 25 percent), while other species, such as striped bass and white perch, experienced survival rates greater than 50 percent, and hardier species, such as freshwater suckers, experienced survival rates greater than 70 percent.

Actual survival rates appeared to be species-specific and likely also dependent upon intake and facility design. EPRI (2005b) indicated that the entrainment survival rate estimates for the studies reviewed by EPRI (2000) were measured largely in the absence of thermal stress, which meant that the temperatures experienced during entrainment were below lethal temperatures. However, in EPRI (2005b), it was noted that the ability of individual entrained organisms to withstand temperature elevations during passage through the cooling water system varies among species. This tolerance is influenced by their genetic ability to adapt to thermal changes and can differ among life stages within the same species. Thus, a fish community in a waterbody having a widely fluctuating natural range of temperatures may have species assemblages with thermal tolerance zones that are wider than those in a waterbody with narrow natural temperature ranges (EPRI 2005b).

A review of entrainment survival studies was also presented by USEPA (2004). Although most of the data were for estuarine species, the data show that survival rates were variable, even within species. For example, for alewife and blueback herring at the Connecticut Yankee Nuclear Power Plant (Connecticut), the survival rate was low, ranging from 0 to 26 percent. Alewife and rainbow smelt larvae at the R. E. Ginna Nuclear Power Plant (New York) had a survival rate of 0 percent. At the Contra Costa Power Plant (California), striped bass survival ranged from 0 to 95 percent. USEPA (2004) indicated that the review of 37 survival studies suggested some limitations and challenges. Some of these limitations and challenges included:

- Different sampling procedures were used by different facilities;
- Much of the information is dated (*e.g.,* from 1970s) and may not be representative of current conditions;
- Even within the same facility for the same species, survival rates varied substantially among years most likely because of changes in environmental conditions, plant operations, and sampling methodology; and,
- There is no rigorous, validated method or model that has been put forward to allow for accurate prediction of survival rates.

USEPA (2004) did indicate, however, some organisms may survive passage through the cooling systems of facilities under different operating conditions.

More recently, entrainment survival study results were presented at a power industry conference in 2015 (Dey et al. 2015). The study locations included Northport Power Station (New York) and E.F. Barrett Power Station (New York), both situated in estuarine environments. Sampling occurred in 2011 from late April through July, with samples collected from noon to midnight 3 days per week and included one collection every 2 hours. Collections were obtained simultaneously from the intake and discharge. For Northport, a total of 263 and 271 samples were obtained from the intake and discharge, respectively. For Barrett, a total of 246 and 214 samples were obtained from the intake and discharge, respectively. To assess survival, larvae were held for 72 hours and eggs were held until hatched. At Northport, a total of 14,571 ichthyoplankton representing 20 taxa were collected, of which 98 percent were eggs. At Barrett, a total of 16,489 ichthyoplankton representing 27 taxa were collected, of which 91 percent were eggs. Based on a maximum-likelihood model approach for entrainment survival, it was determined that there were significant (greater than 60 percent) survival rates for many of the species entrained and that eggs (*e.g.,* bay anchovy) appeared more tolerant of physical entrainment stresses compared to larvae. The majority of entrainment occurred during periods of minimal thermal effect. The results from the two facilities were generally comparable, thus suggesting that the results were transferable (Dey et al. 2015). While USEPA (2004) concluded that the results of one facility are not necessarily predictive of those of another facility, Dey et al. (2015) concluded that entrainment survival rate potential should be considered when selecting BTA.

7.3 Conclusions

Entrainment survival studies conducted at power plants suggest that some species may survive entrainment through the plant and that some percentage of the entrainable population is already dead or dying prior to entering the CWIS, which tempers the 316(b) rule's assumption of 100% mortality caused by the intake and cooling system. While the data are variable by facility and species entrained, studies suggest that eggs may have higher survival than larvae, and that fragile species (gizzard shad) larvae are less likely to survive than hardier species (bass). Survival is also based upon a number of site-specific variables, including hydraulic pathways, residence time in the cooling system, chemical additives, and temperature profile. Even if site-specific studies for pre-entrainment mortality or through-plant mortality have not been conducted, permitting authorities should consider the observations and conclusions of these relevant studies when determining entrainment BTA.

7.4 References

Dey, W., J. Young, and B. Fost. 2015. *Entrainment Survival at Cooling Water Intake Structures – Why it is Important.* Presented at *Clean Water Act* §316(b): Conference on Engineering, Biological and Economic Challenges of the New Existing Facility Rule. Charlotte, NC, November 10-11, 2015.

Electric Power Research Institute (EPRI). 2011. Potential Entrainment of Dead or Moribund Fish Eggs and Larvae at Cooling Water Intake Structures. Report No. 1019860. May 2011.

Electric Power Research Institute (EPRI). 2005b. Impingement and Entrainment Survival Studies Technical Support Document. EPRI Report 1011278.

Electric Power Research Institute (EPRI). 2000. *Review of Entrainment Survival Studies: 1979-2000.* EPRI, Palo Alto, CA. Report ID: 1000757.

Great Lakes Environmental Center (GLEC). 2008. Impingement Mortality and Entrainment Study at the Consumers Energy J.H. Campbell Plant. March 24, 2008.

United States Environmental Protection Agency (USEPA). 2004. *Chapter A7: Entrainment Survival, Regional Analysis Document for the Final Section 316(b) Phase II Existing Facilities Rule.* EPA-821-R-02-003. URL: http://www.epa.gov/sites/production/files/2015-04/documents/cooling-water_phase-2_regional-benefits_2004.pdf.

8 OPERATIONAL STATUS [§122.21(R)(8)]

8.1 Unit Operating Status

The Mill generates power from a steam turbine generator, from two FERC-regulated hydro generators and relies on the external electric grid for the supply of mill power needs. Cooling water is used to cool the steam turbine condenser, for other non-contact uses, and a portion is reused for paper-producing processes that are centered around the Mill's three paper machines. Their operating information is described below. Typically, all three machines are concurrently operating.

Paper Machine Summary

	Machine 1	Machine 3	Machine 4
Product Description	Unbleached semi-chem corrugated medium	Unbleached semi-chem corrugated medium	Unbleached recycled linerboard
Initial Year of Operation	1928	1959	1996

The current Big Island Mill paper machines are expected to continue operating at current production levels for the foreseeable future. As such, significant changes in cooling water demand associated with planned production changes are not expected.

8.2 Production Processes

The Big Island Mill does not intend to propose future reductions in flow directly associated with production process changes or changes in production process operations to meet the requirements of 40 CFR 125.94(c). Therefore, this section is not applicable.

8.3 Production Schedules

The production schedule at the Big Island Mill does not impact CWIS intake flow. Fluctuations in intake flows are typically due to changes in ambient temperature and thus cooling water demand. The Mill does not foresee altering or adding any processes that would have a significant impact on the facility's CWIS operation, such that there would be an impact on a best technology available determination in the permit term associated with the submittal of this report.

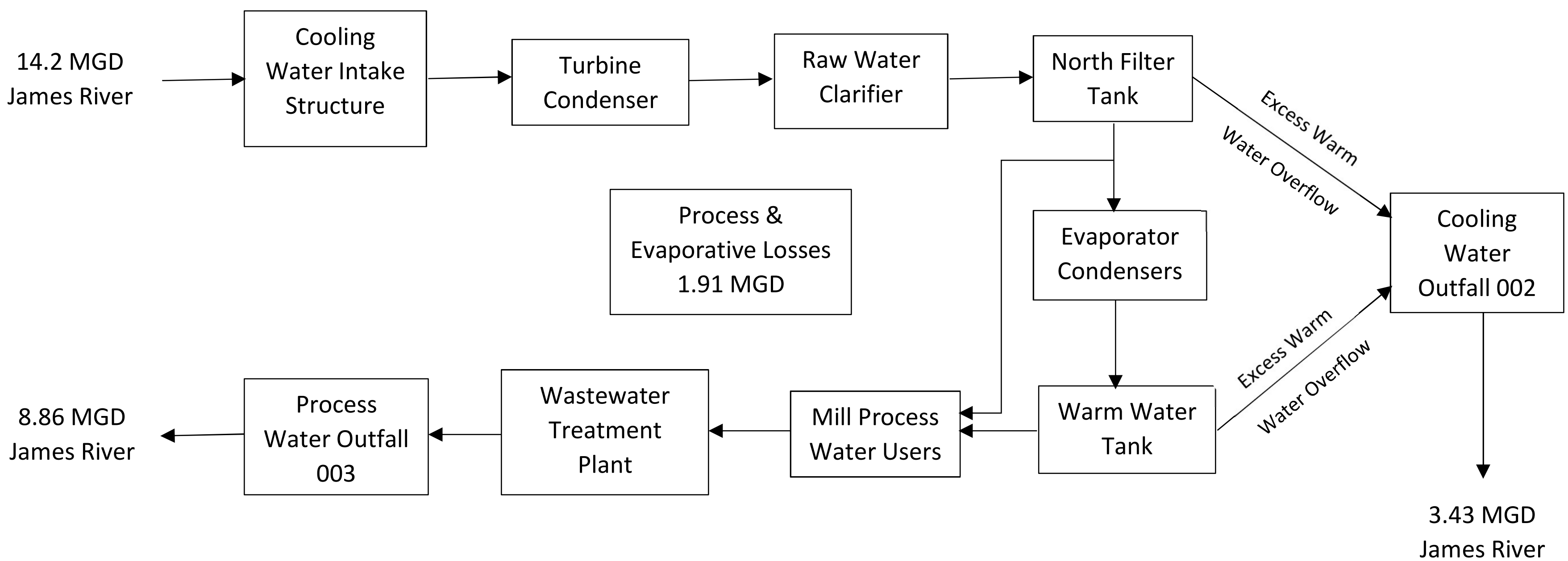
8.4 New Units Planned Within Next 5 Years

There are no new process units that are planned within the next 5 years that will have an impact or a net change on the CWIS operation or cooling water flow.

APPENDIX A

Water Balance Diagram

GP Big Island, LLC Simplified Water Flow Diagram for Cooling Water Intake Structure



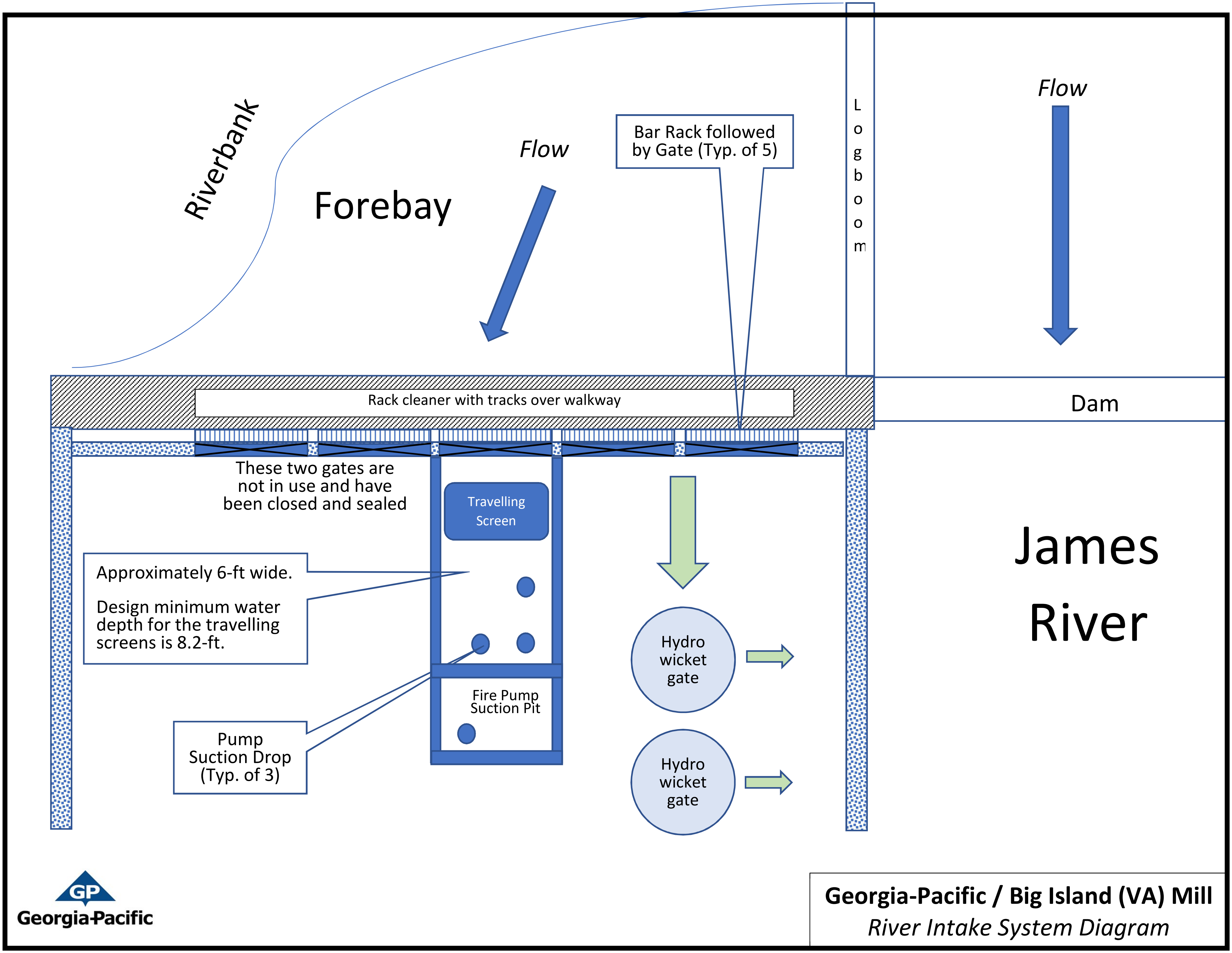
NOTE: Flows are averages for the period 2016 through 2018

Georgia-Pacific

Georgia-Pacific / Big Island (VA) Mill
Water Balance Diagram

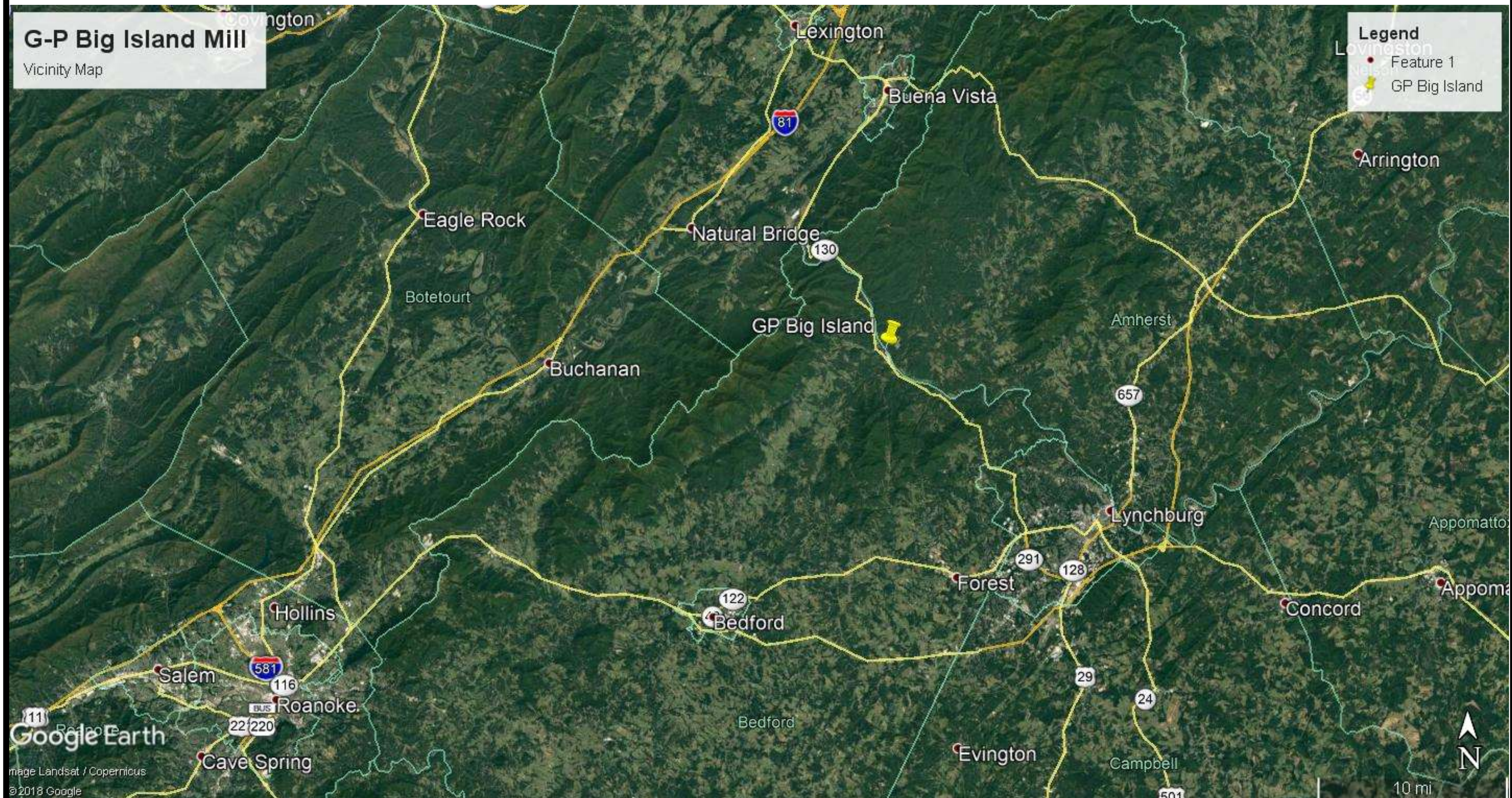
APPENDIX B

Engineering Drawings


Riverbank
Forebay
Flow
Bar Rack followed by Gate (Typ. of 5)
Logboom
Flow
Rack cleaner with tracks over walkway
Dam
These two gates are not in use and have been closed and sealed
Travelling Screen
Approximately 6-ft wide.
Design minimum water depth for the travelling screens is 8.2-ft.
Hydro wicket gate
Hydro wicket gate
James River
Fire Pump Suction Pit
Pump Suction Drop (Typ. of 3)
Georgia-Pacific
Georgia-Pacific / Big Island (VA) Mill
River Intake System Diagram

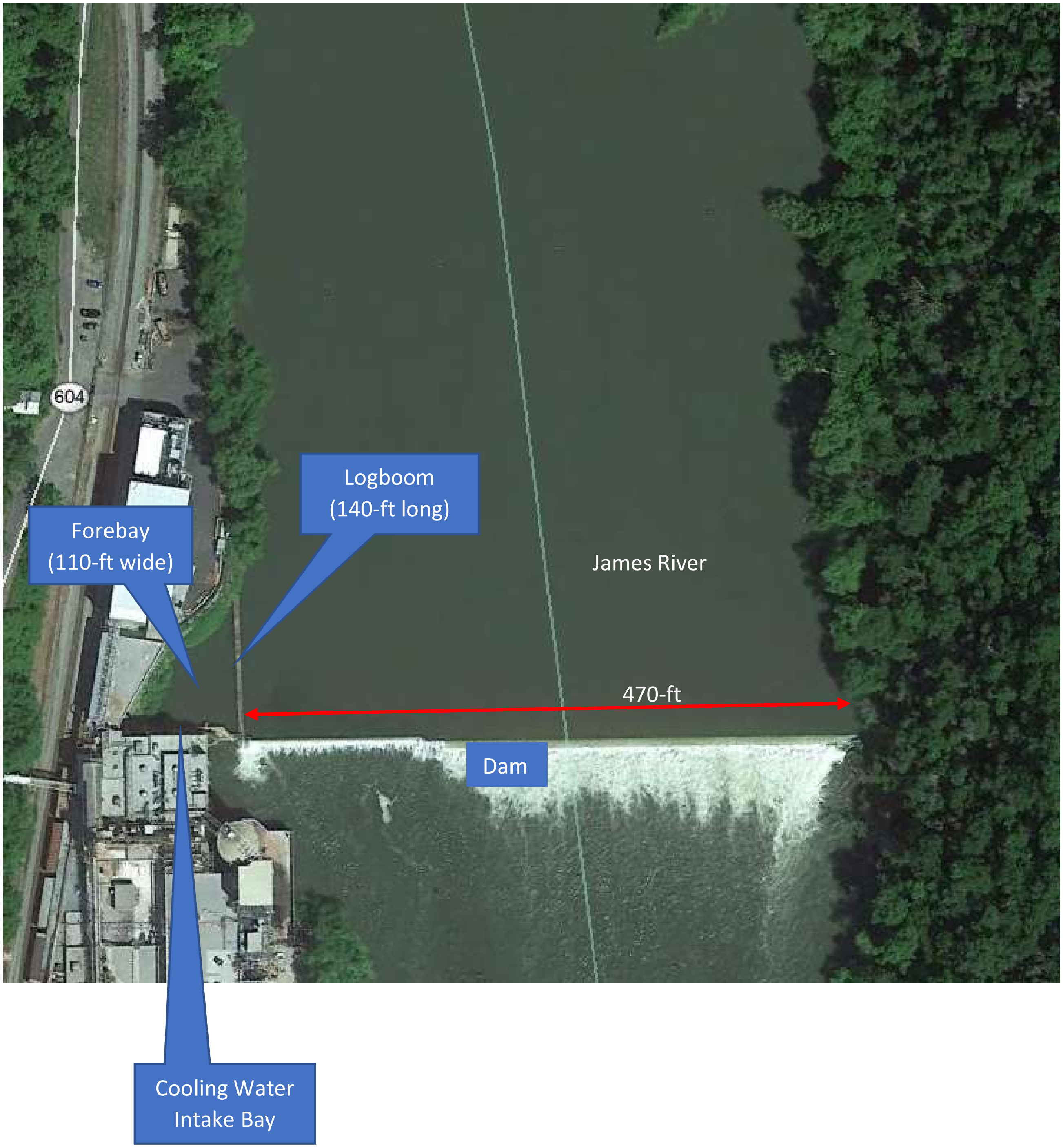
APPENDIX C

Vicinity Maps



Georgia-Pacific

Georgia-Pacific / Big Island (VA) Mill
Vicinity Map



Georgia-Pacific

Georgia-Pacific / Big Island (VA) Mill

River Intake

APPENDIX D

Supporting Calculations

ARCADIS	GEORGIA-PACIFIC BIG ISLAND, VA	REV	DEV'D
		0	T. Boykin
	Supporting Calculations for 40 CFR § 122.21(r)(3) Report		

Through-Slot Velocity Through the Bar Rack

Assumptions:

1. The assumed blockage of the coarse bar screen due to debris buildup is: 10%

Calculation Methodology:

$A_{screen} = W * D_{screen} * P$ **(Formula 1)**

Where:

W = channel width in ft

D_{screen} = submerged depth of the bar screen in ft

P = screen open area in % (Formula 6)

and $P = (1 - S) * [1 - (B * (W_B /12) / W)]$ **(Formula 2)**

Where:

S = assumed blockage of the screen due to debris in %

B = number of bars in the screen

W_B = bar thickness in inches

W = channel width in ft

Calculation Inputs:

Design Intake Flow (DIF)	21.6	MGD	33.4	cu. ft/s
Actual Intake Flow (AIF)	14.2	MGD	22.0	cu. ft/s
Scenario Flow	18.0	MGD	27.9	cu. ft/s
Channel Width	10.50	ft	126.0	in
Bar Rack Specifications				
Minimum design water depth	8.20	ft		

Scenario: Calculate through-slot velocity at DIF and AIF at LWL

	DIF	AIF	Scenario
Qrack, cfs	33.4	22.0	27.9
W, ft	10.5	10.5	10.5
D (min water level), ft	8.2	8.2	8.2
S, %	10%	10%	10%
B	67	67	67
W_B, in	0.375	0.375	0.375
P, %	72%	72%	72%
V_{rack}, fps	**0.54**	**0.35**	**0.45**

Scenario: Calculate Radial Velocity Profiles at DIF and AIF at LWL and Different Velocities

	DIF	AIF
Qrack, cfs	33.4	22.0
D (min water level), ft	8.2	8.2
Velocity, fps	0.5	0.5
Resulting Radius of AOI, ft	**2.6**	**1.7**
V_{rack}, fps	0.25	0.25
Resulting Radius of AOI, ft	**5.19**	**3.41**
V_{rack}, fps	0.05	0.05
Resulting Radius of AOI, ft	**25.95**	**17.06**

Arcadis U.S., Inc.

9954 Mayland Drive

Suite 2400

Richmond, Virginia 23233

Tel 804 740 0181

Fax 804 217 8292

www.arcadis.com